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⑰ **Electric cable glands.**

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EP 0 093 524 B1

Description

This invention relates to terminations for electric cables with metallic sheaths or other metallic covering layers and a method of making them.

It is a normal requirement when glands are used in cable terminations to ensure "earth continuity" by providing an electrical connection between the cable sheath (or other conductive covering layer) and the body, or some other accessible member, of the gland. This presents difficulties, especially when the layer to be contacted is a corrugated sheath, as different manufacturers use different corrugation profiles (and some annular and others helical ones), and even for a given cable the effective contact radius varies rapidly along the length of the cable (and in the case of helical corrugations around the circumference as well).

Contact-making devices comprising resilient contact fingers (US-A-4022966), usually backed up with rubber compression rings (US-A-2816949), have been tried but are not wholly satisfactory because movements under thermal and mechanical stresses are liable to result in insecure contacts, or even fracture of the fingers in some cases.

The Applicants have been marketing for a number of years (GB-A-1524684) a cable gland (commonly referred to as a "Barrier Gland") comprising two tubular members each wider at one end than at the other and telescopically engageable at their respective wider ends to define an annular chamber around a cable end inserted through the telescoped members, and means for urging the tubular members axially together to reduce the volume of the annular chamber.

In use, the annular chamber is filled with a hard-setting insulating sealing material in a pasty or viscous condition, and the insulating sealing material is pressurised by urging the tubular members together before it sets, in order to provide a fluid-tight, pressure-tight and/or flameproof seal.

To allow the gland to be released, if required, from the apparatus to which the cable is connected without destroying the body of set insulating sealing material, the tubular members are preferably urged together by outer members that enclose them and are screwed together either by a direct threaded engagement between them or with drawbolts or the like; when a flameproof gland is required, one of the outer members should fit one of the tubular members closely enough over a sufficient axial length to form a joint that satisfies flameproof requirements (a flame gap or flameproof path); typical requirements for an unthreaded joint would be for a diametral clearance less than 0.3 mm and an axial length of at least 12.5 mm. Manufacturing tolerances in such cases can be eased by centring, e.g. by providing them with mating conical surfaces.

Others (GB-A-2056191) have attempted to provide contact fingers in a barrier gland, but have located them outside the chamber filled with insulating sealing material.

The present invention is characterised by the fact that at least one resilient contact finger in electrical continuity with and projecting inwardly from one of the tubular members of the gland to contact a conductive part of the cable is embedded in, and locked in position by, the set insulating sealing material.

The set insulating sealing material holds them rigidly in fixed positions in the finished termination.

The finger or fingers may be supported at one or both ends; the width of the (or each) finger may vary along its length, but will be small compared with the circumference of the annular chamber. Preferably there are a plurality of contact fingers distributed around the circumference of the gland; preferably they are all formed as inward projections from a common annular or nearly annular body, such as a split or solid tube or a slit or solid annular disc of a suitable resilient metal, for example beryllium copper, phosphor-bronze, stainless steel or even mild steel. This body may be force-fitted in the relevant tubular member or could be welded, rivetted or otherwise secured to it.

Prior to fitting on the cable, the finger(s), if supported at one end only, may extend either radially or obliquely, in the latter case preferably with the free end(s) nearer to the position that will be occupied by the apparatus to which the cable is to be connected than the fixed end(s).

Although the terminations of the inventions of the invention are primarily intended for use with corrugated cable sheaths of aluminium, copper, steel, etc., they can be made effectively on cables that include a smooth metallic sheath, e.g. of lead, or lapped tape armour of tinned steel etc.

The invention will be further described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a cross-section through one particular form of termination in accordance with the invention; and

Figure 2 is an end-view of a finger assembly forming part of the termination of Figure 1;

Figure 3 is an enlarged, simplified cross-section of the line III-III in Figure 2;

Figure 4 is a plan view of a length of stamped strip for making the finger assembly of Figure 2;

Figure 5 is a partly-sectioned view of a modified form of gland in accordance with the invention;

Figures 6-8 show stamped strips alternative to the one shown in Figure 4;

Figure 9 is a composite view showing three forms of finger assembly alternative to the one shown Figure 2;

Figures 10, 11 and 12 show three ways of making the assembly shown in Figure 9;

Figures 13 and 14 show two more alternative finger assemblies, which can be used separately or together; and

Figures 15 to 17 illustrate another alternative finger assembly and its use.

Referring first to Figure 1, this shows a flameproof termination for a three-core electric cable

with a corrugated metal sheath 1 and a protective oversheath 2 of plastics material. In making this termination, a contact ring 3 is made by taking a short length from a phosphor bronze strip previously punched to form a number of fingers on one of its sides, rolling the cut length to form it into a tube and then bending each of the fingers 4 (Figures 2 and 3) sharply so as to exceed the elastic limit and leave each finger projecting radially inwards; the circular form can be retained by a circlip, interlocking, welding, etc., if required.

Figure 4 shows one form of punched strip, which, cut to appropriate lengths, can be used for various sizes of contact ring. The opposite side 5 of the phosphor bronze strip may be flanged if desired to strengthen it. This contact ring is snapp-fitted into an undercut recess in the inner surface of a first tubular member 6 (Figure 1) which is wider at its right hand end than its left. This tubular member 6 supports an outer seal assembly 7 consisting of an elastomeric sealing ring 8 with skid washers 9 and a gland nut 10 threaded on the tubular member 6. This assembly, together with an outer gland nut 11 (whose function is to be explained later) is slipped over the prepared cable end and the gland nut 10 is tightened to compress the sealing ring 8 and so locate the tubular member 6 on the cable end.

A suitable quantity of a resinous insulating sealing material in the form of a putty, such as that sold by the Applicants under the trade mark "Bicaseal", is now made up and filled into the open end of the tubular member 6, and into the crutch of the cable, to a diameter roughly equal to the diameter of the mouth of the tubular member 6.

A second tubular member 12, which is wider at its left hand end than its right hand end, is now threaded over the ends of the conductors 13 and telescoped with the free end of the tubular member 6. Members 6 and 12 are then urged together using the outer gland nut 11 and an outer body member 14 which are screw threaded together. The body 14 may already be fitted in the apparatus to which a connection is to be made, or it could be fitted later, as detailed below. By urging the members 6 and 12 together, pressure is generated in the insulating sealing material in the chamber 15, ensuring that it is void-free and makes an effective seal as well as locking the fingers 4 in position.

The tubular member 12 is self-centring in the body portion 14 through the action of conical contact surfaces at 16 and the length of the joint between them (which is in fact the full length of the body 14), is sufficient to ensure a joint that meets flameproof requirements.

When the insulating sealing material is set, it adheres firmly to the tubular members 6 and 12, but the outer members 11 and 14 are not in contact with the insulating sealing material and can be unscrewed as required. If the body member is not already fixed in position in the apparatus, the outer gland nut 11 can be unscrewed to allow the body member 14 to be

rotated for screwing it into the wall of the apparatus, and the gland then re-assembled. This process can be repeated, without detriment to the seal, if it is necessary to replace the whole or any relevant part of the apparatus.

The gland shown in Figure 5 is designed for use with a cable having wire armour over the sheathing layer to which contact is to be made by the fingers 4. The first tubular member 17 (corresponding to 6 in Figure 1) is modified to provide a cone 18 on which the ends of the armour wires are laid and secured with a clamping ring 19 urged into engagement by a gland barrel 20 threaded on the body 14. This is done in a preliminary step prior to insertion of insulating sealing material into the chamber 15 in order to lock the tubular member 17 in position. After unscrewing the barrel, the subsequent procedure is substantially as before, except that the outer seal 21 needs to be tightened after the barrel has been finally screwed up.

Figure 5 also illustrates the use of a circlip 22 to hold the finger assembly 3 more securely in position.

As illustrated by Figures 6 to 8, the fingers 4 may be parallel-sided or tapered, and their ends may be straight, convex or concave.

As illustrated by Figures 7 to 12, instead of rolling the finger assembly 3 from a punched strip and bending the fingers inwards, it may be stamped in flat disc form from sheet metal and the fingers 4 subsequently bent outwards (if necessary); the disc form assembly may be force-fitted in the tubular mounting member 33 (Figure 10), locked in position by local deformations 24 (Figure 11) or secured with a threaded ring 25 (Figure 12).

A further alternative is to form the finger assembly from a seamless or welded tube 26 (Figures 13 to 14) with the fingers 4 bent through an appropriate angle, either obtuse or acute. Two or more finger assemblies could be used for added security.

Figures 15 to 17 illustrate the use of fingers that are supported at both ends, which may have advantages if the layer of the cable to be contacted is liable to be torn; for example a thin metal tape layer. Fingers 27 are formed by punching rectangular holes in a metal sheet which is subsequently rolled to form a tube 28 (or a preformed tube could be used, but is more difficult to fabricate); the fingers are bowed inwardly by applying axial pressure while preventing any outward movement (as shown in Figure 16) or by a squeezing action. Figure 17 illustrates one practical way of applying axial pressure by means of a ring 28 threaded in the mounting member 23.

Claims

1. A cable termination comprising two tubular gland members (6, 12) each wider at one end than at the other end and telescopically engaged at their respective wider ends to define an annular chamber (15) around a cable end inserted through

the telescoped members, and an insulating sealing material of the type that, before its introduction into the said chamber, is in a viscous or pasty condition so as to be compressed when the tubular members are urged axially together to reduce the volume of the annular chamber said sealing material being hardenable to a set condition, characterised in that at least one resilient contact finger (4) in electrical continuity with and projecting inwardly from one of the said tubular members to contact a conductive part (1) of the cable is embedded in, and locked in position by, the set insulating sealing material.

2. A termination as claimed in Claim 1 in which the tubular members are urged together by outer members (11, 14) that enclose them and that are screwed together.

3. A termination as claimed in Claim 2 in which one of the outer members (14) fits one of the tubular members 12 closely enough to establish a diametral clearance of less than 0.3 mm over an axial length of at least 12.5 mm.

4. A termination as claimed in any one of the preceding claims in which there are a plurality of contact fingers (4) distributed around the circumference of the gland.

5. A termination as claimed in Claim 4 in which all the contact fingers (4) are formed as inward projections from a common annular or nearly annular body.

6. A method of making a cable termination comprising providing a cable gland comprising two tubular members (6, 12) each wider at one end than at the other end and telescopically engageable at their respective wider ends to define an annular chamber (15) around a cable end inserted through the telescoped members, and means (11, 14) for urging the tubular members axially together to reduce the volume of the annular chamber, filling the annular chamber with a hard setting insulating sealing material in a pasty or viscous condition and pressurising the insulating sealing material by urging the tubular member together before it sets characterised by providing at least one resilient contact finger (4) in electrical continuity with and projecting inwardly from one of the said tubular members within the said chamber (15) so that the insulating sealing material embeds the contact finger(s) and locks it or them in position.

Patentansprüche

1. Kabelanschluß, der zwei rohrförmige Durchführungsteile (6, 12) aufweist, die jeweils an einem Ende breiter als am anderen Ende sind und teleskopartig an ihren jeweils breiteren Enden zusammenarbeiten, um einen Ringraum (15) um ein Kabelende zu bilden, das durch die teleskopartigen Teile durchgeführt ist, und ein isolierendes Dichtmaterial derart aufweist, daß es vor dem Einführen in die Kammer im viskosen oder pastösen Zustand ist, um zusammengedrückt zu werden, wenn die rohrförmigen Teile axial zusammengedrückt werden, um das Volumen der

Ringkammer zu reduzieren, wobei das Dichtungsmaterial in einen Erstarrungszustand härtbar ist, dadurch gekennzeichnet, daß wenigstens ein federnd nachgiebiger Kontaktfinger (4), der in elektrischem Schluß mit einem der rohrförmigen Elemente ist und von einem derselben nach innen ragt, um einen leitenden Teil (1) des Kabels zu kontaktieren, in das verfestigte isolierende Dichtmaterial eingebettet und durch dasselbe an Ort und Stelle festgelegt ist.

2. Anschluß nach Anspruch 1, bei dem die rohrförmigen Teile durch äußere Teile (11,14) zusammengedrückt werden, die diese umgeben, und daß diese zusammengeschraubt werden.

3. Anschluß nach Anspruch 2, bei dem die äußeren Teile (14) zu einem der rohrförmigen Teile (12) eng genug paßt, um ein Durchmesser-spiel von weniger als 0,3 mm über eine axiale Länge von wenigstens 12,5 mm zu erhalten.

4. Anschluß nach einem der vorangehenden Ansprüche, bei dem eine Mehrzahl von Kontaktfingern (4) um den Umfang der Durchführung verteilt vorgesehen ist.

5. Anschluß nach Anspruch 4, bei dem alle Kontaktfinger (4) als nach innen weisende Vorsprünge von einem gemeinsamen ringförmigen oder nahezu ringförmigen Körper gebildet werden.

6. Verfahren zum Herstellen eines Kabelanschlusses, bei dem eine Kabeldurchführung vorgesehen wird, die zwei rohrförmige Teile (6, 12) aufweist, die jeweils an einem Ende breiter als am andere Ende sind und die teleskopartig an ihren jeweils breiteren Enden zusammenarbeiten, um einen Ringraum (15) um ein Kabelende zu bilden, das durch die teleskopartigen Teile durchgeführt wird, und eine Einrichtung (11, 14) aufweist, welche die rohrförmigen Teile axial zusammendrückt, um das Volumen der Ringkammer zu reduzieren, bei dem die Ringkammer mit einem hart erstarrbaren isolierenden Dichtmaterial in einem pastösen oder viskosen Zustand geführt wird und das isolierende Dichtmaterial durch Zusammendrücken des rohrförmigen Teils vor dem Erstarren mit Druck beaufschlagt wird, dadurch gekennzeichnet, daß wenigstens ein federnd nachgiebiger Kontaktfinger (4) in elektrischem Schluß mit einem der rohrförmigen Teile und von diesem nach innen ragend in der Kammer (15) vorgesehen wird, so daß das isolierende Dichtmaterial den oder die Kontaktfinger einbettet und ihn oder sie in der Position festlegt.

Revendications

1. Terminaison pour câble comportant deux éléments de presse-étoupe tubulaires (6, 12) chacun plus large à une extrémité qu'à l'autre extrémité et emboîtés de façon télescopique à leurs extrémités les plus larges respectives de façon à définir une chambre annulaire (15) autour d'une extrémité de câble insérée à travers les éléments télescopiques, et un matériau de scellement isolant du type qui, avant son introduction à l'intérieur de ladite chambre, se trouve dans un état

visqueux ou pâteux de façon à être comprimé lorsque les éléments tubulaires sont poussés axialement l'un contre l'autre afin de réduire le volume de la chambre annulaire, ledit matériau de scellement étant durcissable jusqu'à un état où il a pris, caractérisée en ce qu'au moins un doigt de contact élastique (4) en continuité électrique avec l'un desdits éléments tubulaires et s'étendant vers l'intérieur à partir de celui-ci de façon à venir en contact avec une partie conductrice (1) du câble est enrobé dans le matériau de scellement isolant pris et maintenu en position par celui-ci.

2. Terminaison selon la revendication 1, dans laquelle les éléments tubulaires sont poussés l'un contre l'autre par des éléments extérieurs (11, 14) qui les entourent et qui sont vissés ensemble.

3. Terminaison selon la revendication 2, dans laquelle l'un des éléments extérieurs (14) s'adapte suffisamment étroitement sur l'un des éléments tubulaires (12) pour établir un espacement diamétral inférieur à 0,3 mm sur une longueur axiale d'au moins 12,5 mm.

4. Terminaison selon l'une quelconque des revendications précédentes dans laquelle il existe une pluralité de doigts de contact (4) répartis autour de la circonférence du presse-étoupe.

5. Terminaison selon la revendication 4 dans

laquelle tous les doigts de contact (4) sont formés par des saillies s'étendant vers l'intérieur à partir d'un corps commun annulaire ou quasi annulaire.

6. Procédé pour fabriquer une terminaison pour câble comportant l'utilisation d'un presse-étoupe pour câble comportant deux éléments tubulaires (6, 12) plus larges chacun à une extrémité qu'à l'autre extrémité et pouvant s'emboîter de façon télescopique à leurs extrémités les plus larges respectives de façon à définir une chambre annulaire (15) autour d'une extrémité de câble insérée à travers les éléments télescopiques, et des moyens (11, 14) pour pousser les éléments tubulaires axialement l'un vers l'autre afin de réduire le volume de la chambre annulaire, le remplissage de la chambre annulaire avec un matériau de scellement isolant durcissable sous un état pâteux ou visqueux et la compression du matériau de scellement isolant en poussant les éléments tubulaires l'un contre l'autre avant sa prise, caractérisé par la disposition d'au moins un doigt de contact élastique (4) en continuité électrique avec l'un desdits éléments tubulaires et s'étendant vers l'intérieur à partir de celui-ci à l'intérieur de ladite chambre (15) de telle sorte que le matériau de scellement isolant enrobe le(s) doigt(s) de contact et le ou les maintienne en place.

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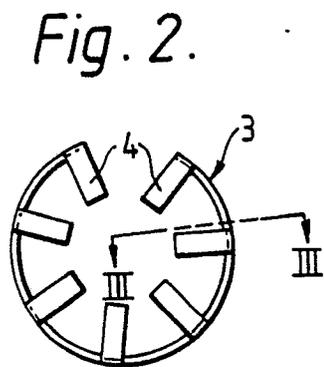
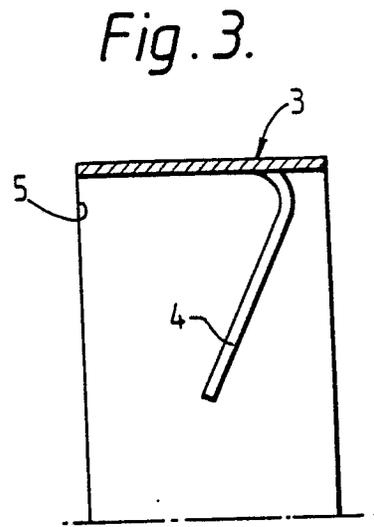
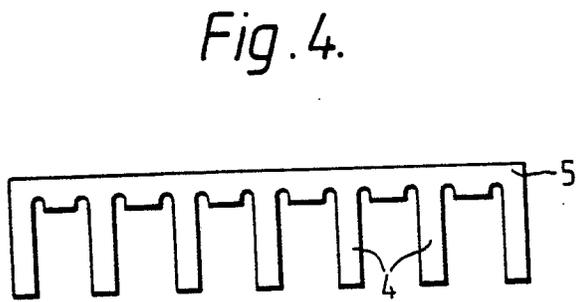
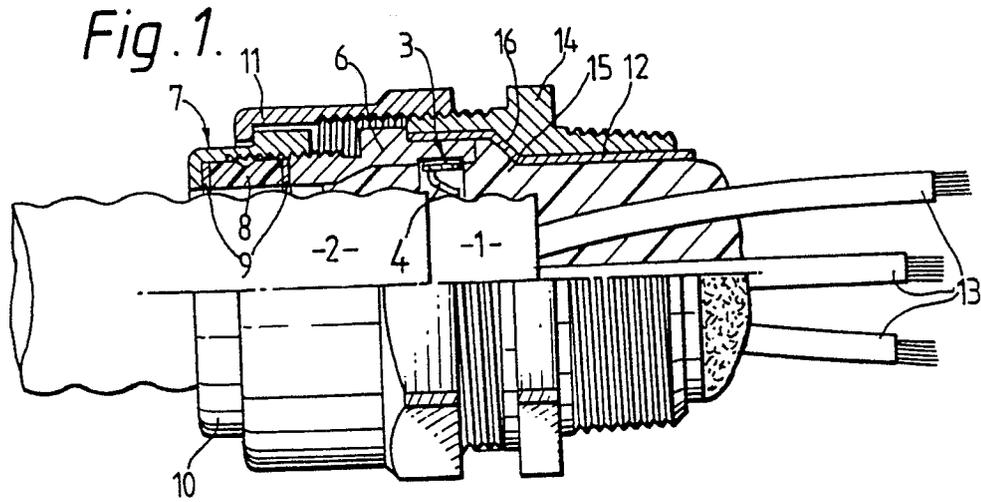


Fig. 5.

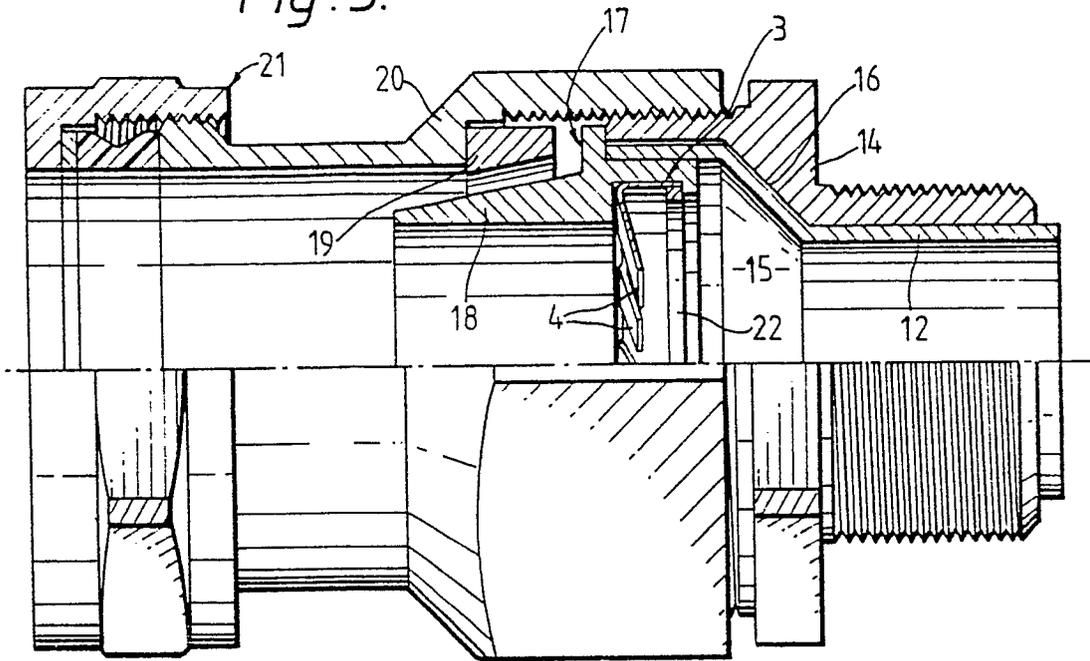


Fig. 6.

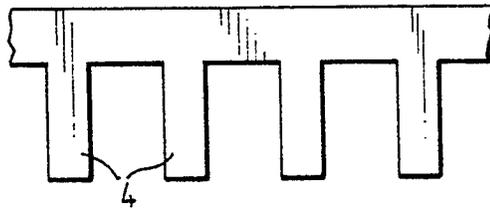


Fig. 7.

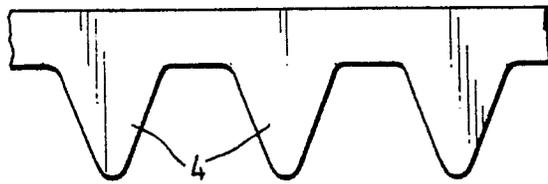


Fig. 8.

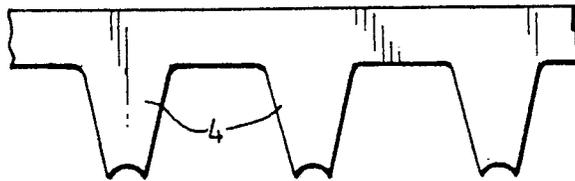


Fig. 9.

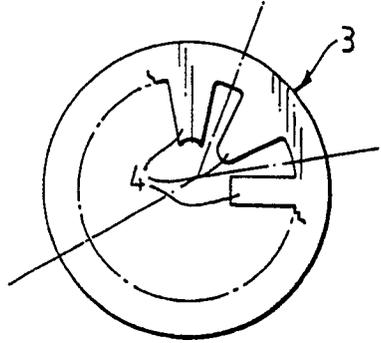


Fig. 13.

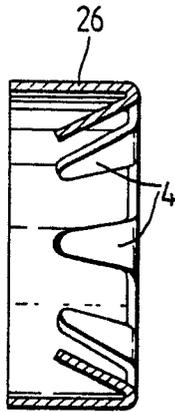


Fig. 14.

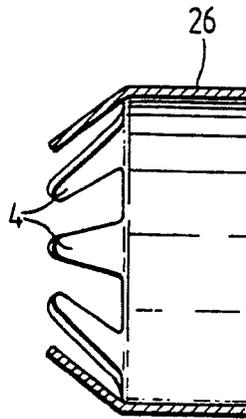


Fig. 10

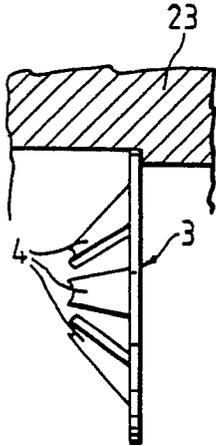


Fig. 11.

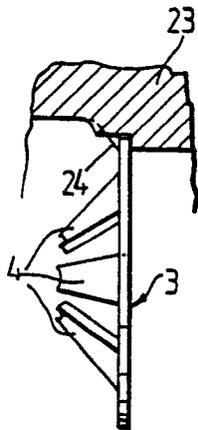


Fig. 12.

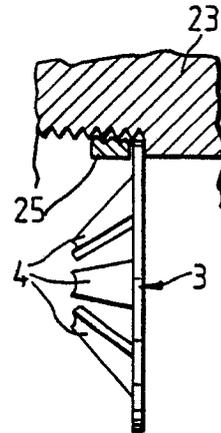


Fig. 15.

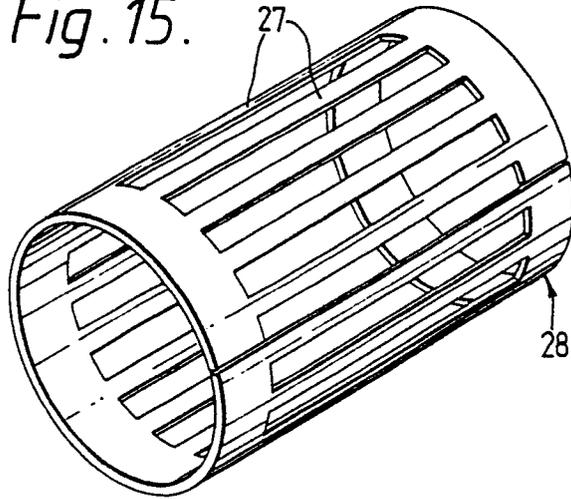


Fig. 16.

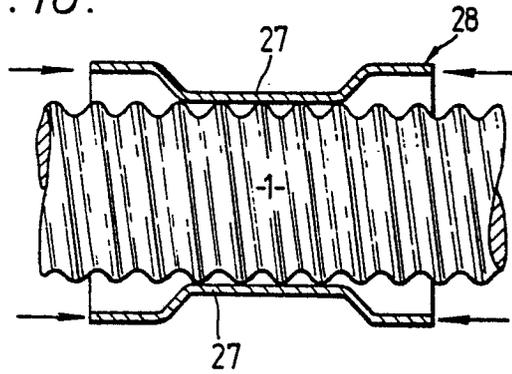


Fig. 17.

